

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Application

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Applicant(s): Driesen et al.

Case: 5-3

Serial No.: 10/562,617

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Group: 2617

Examiner: Yu Gu

Title: Method and Apparatus For Backwards Compatible Communication in a Multiple Antenna Communication System Using FDM-Based Preamble Structures

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APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
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20 Sir:

Applicants hereby appeal the final rejection dated May 17, 2010, of claims 1 through 30 of the above-identified patent application.

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REAL PARTY IN INTEREST

The present application is assigned to Agere Systems Inc., as evidenced by an assignment recorded on May 24, 2006 in the United States Patent and Trademark Office at Reel 017680, Frame 0187. The assignee, Agere Systems Inc., is the real party in interest.

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RELATED APPEALS AND INTERFERENCES

A Notice of Appeal was filed on June 18, 2009 and an Appeal Brief was filed on August 6, 2009 for related United States Application Serial No. 10/562,619 and a Notice of Appeal was filed on June 23, 2010 and an Appeal Brief was filed on July 2, 2010 for related United States Application Serial No. 10/562,620.

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STATUS OF CLAIMS

Claims 1 through 30 are pending in the above-identified patent application. Claims 1, 4, 8-10, 12, 13, 15, 18, 22, 23, and 25-30 are rejected under 35 U.S.C. §103(a) as being unpatentable over Perahia et al. (United States Patent Number 7,352,688) in view of Ma et al. (United States Patent Publication Number 2007/0064586; hereinafter Ma '586), and further in view of Ma et al. (United States Publication Number 2003/0072255; hereinafter Ma '255), claims 2, 5, 6, 11, 16, 19, 20, and 24 are rejected under 35 U.S.C. §103(a) as being unpatentable over Perahia et al. in view of Ma '586 and Ma '255, and further in view of Shattil (United States Patent Publication Number 2004/0141548), claims 3, 7, 17, and 21 are rejected under 35 U.S.C. §103(a) as being unpatentable over Perahia et al. in view of Ma '586 and Ma '255, and further in view of Zhuang et al. (United States Patent Publication Number 2003/0123381), and claim 14 is rejected under 35 U.S.C. §103(a) as being unpatentable over Perahia et al. in view of Ma '586 and Ma '255, and further in view of Jia et al. (United States Patent Number 7,103,325).

Claims 1, 6, 15, 20, 27 and 30 are being appealed.

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STATUS OF AMENDMENTS

The amendments filed subsequent to the final rejection have been entered.

SUMMARY OF CLAIMED SUBJECT MATTER

Independent claim 1 is directed to a method for transmitting data in a multiple antenna communication system having N transmit antennas (FIG. 1; page 4, line 25, to page 5, line 7), the method comprising the step of:

transmitting on each of the N transmit antennas a legacy preamble having at least one long training symbol, and at least one additional long training symbol (page 3, lines 5-13),
25 each of the long training symbols to be transmitted on each of the N transmit antennas having two or more portions (page 3, lines 14-21), each of the N transmit antennas having a set of a plurality of subcarriers, wherein each of the sets of the plurality of subcarriers are grouped into a plurality of subcarrier subgroups (page 6, line 29, to page 7, line 4), wherein each subcarrier subgroup comprises two or more adjacent subcarriers (page 6, line 29, to page 7, line 4; and page
30 8, lines 13-16) and wherein each portion of each long training symbol is transmitted on a different transmit antenna in a given time interval using one of the plurality of subcarrier

subgroups (FIG. 7; page 7, lines 14-31; and page 8, lines 11-30).

Claims 6 and 20 require wherein after transmission of the N long training symbols by each of the N transmit antennas, each of the N transmit antennas has transmitted each subcarrier of the long training symbols only once (page 3, lines 18-21).

5 Independent claim 15 is directed to a transmitter in a multiple antenna communication system (FIG. 1; page 4, line 25, to page 5, line 7), comprising:

N transmit antennas for transmitting a legacy preamble having at least one long training symbol, and at least one additional long training symbol on each of the N transmit antennas (page 3, lines 5-13), each of the long training symbols to be transmitted on each of the

10 N transmit antennas having two or more portions (page 3, lines 14-21), each of the N transmit antennas having a set of a plurality of subcarriers, wherein each of the sets of the plurality of subcarriers are grouped into a plurality of subcarrier subgroups (page 6, line 29, to page 7, line 4), wherein each subcarrier subgroup comprises two or more adjacent subcarriers (page 6, line 29, to page 7, line 4; and page 8, lines 13-16) and wherein each portion of each long training symbol is transmitted on a different transmit antenna in a given time interval using one of the 15 plurality of subcarrier subgroups (FIG. 7; page 7, lines 14-31; and page 8, lines 11-30).

Independent claim 27 is directed to a method for receiving data on at least one receive antenna transmitted by a transmitter having N transmit antennas in a multiple antenna communication system (FIG. 1; page 4, line 25, to page 7, line 2; and page 10, lines 9-18), the 20 method comprising the steps of:

receiving a legacy preamble having at least one long training symbol and an indication of a duration of a transmission of the data (page 12, lines 9-20), and at least one additional long training symbols on each of the N transmit antennas (page 3, lines 5-13), each of the long training symbols to be transmitted on each of the N transmit antennas having two or 25 more portions (page 3, lines 14-21), each of the N transmit antennas having a set of a plurality of subcarriers, wherein each of the sets of the plurality of subcarriers are grouped into a plurality of subcarrier subgroups (page 6, line 29, to page 7, line 4), wherein each of the subcarrier subgroups comprises two or more adjacent subcarriers (page 6, line 29, to page 7, line 4; and page 8, lines 13-16) and wherein each portion of each long training symbol is transmitted on a 30 different transmit antenna in a given time interval using one of the plurality of subcarrier subgroups (FIG. 7; page 7, lines 14-31; and page 8, lines 11-30); and

deferring for the indicated duration of the transmission of the data (page 12, lines 9-20).

Independent claim 30 is directed to a receiver (FIG. 9: 900) in a multiple antenna communication system having at least one transmitter having N transmit antennas (FIG. 1; page 5, line 25, to page 5, line 7; and page 10, lines 9-18), comprising:

at least one receive antenna for receiving a legacy preamble having at least one long training symbol and an indication of a duration of a transmission of the data (page 12, lines 9-20), and N-1 additional long training symbols on each of the N transmit antennas (page 3, lines 5-13), each of the long training symbols to be transmitted on each of the N transmit antennas 10 having two or more portions (page 3, lines 14-21), each of the N transmit antennas having a set of a plurality of subcarriers, wherein each of the sets of the plurality of subcarriers are grouped into a plurality of subcarrier subgroups (page 6, line 29, to page 7, line 4), wherein each of the subcarrier subgroups comprises two or more adjacent subcarriers (page 6, line 29, to page 7, line 4; and page 8, lines 13-16) and wherein each portion of each long training symbol is transmitted 15 on a different transmit antenna in a given time interval using one of the plurality of subcarrier subgroups (FIG. 7; page 7, lines 14-31; and page 8, lines 11-30); and

means for deferring for the indicated duration of the transmission of the data (page 12, lines 9-20).

20 STATEMENT OF GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1, 4, 8-10, 12, 13, 15, 18, 22, 23, and 25-30 are rejected under 35 U.S.C. §103(a) as being unpatentable over Perahia et al. in view of Ma et al., and further in view of Ma et al., claims 2, 5, 6, 11, 16, 19, 20, and 24 are rejected under 35 U.S.C. §103(a) as being unpatentable over Perahia et al. in view of Ma '586 and Ma '255, and further in view of Shattil, 25 claims 3, 7, 17, and 21 are rejected under 35 U.S.C. §103(a) as being unpatentable over Perahia et al. in view of Ma '586 and Ma '255, and further in view of Zhuang et al., and claim 14 is rejected under 35 U.S.C. §103(a) as being unpatentable over Perahia et al. in view of Ma '586 and Ma '255, and further in view of Jia et al.

ARGUMENT

Independent Claims 1, 15, 27 and 30

Independent claims 1, 15, 27 and 30 were rejected under 35 U.S.C. §103(a) as being unpatentable over Perahia et al. in view of Ma '586 and Ma '255. Regarding claim 1, the
5 Examiner acknowledges that Perahia may have failed to disclose each of said long training symbols to be transmitted on each of said N transmit antennas having two or more portions, each of said N transmit antennas having a set of a plurality of subcarriers, wherein each of said sets of said plurality of subcarriers are grouped into a plurality of subcarrier subgroups, wherein each subcarrier subgroup comprises two or more adjacent subcarriers and wherein each portion of
10 each long training symbol is transmitted on a different transmit antenna in a given time interval using a subcarrier subgroup. The Examiner asserts, however, that Ma '586 discloses transmitting a symbol (e.g. header symbol) in which subcarriers of a header OFDM symbol are divided into a set of subcarriers of each plurality of antennas, with each antenna transmitting the header symbol only on the respective set of subcarriers (i.e., each antenna has a set of subcarriers different from
15 others) (paragraphs [0017]-[0018]). The Examiner further asserts that, contrary to Applicant's assertion, non-contiguous does not mean non-adjacent, but rather non-repetitive. The Examiner asserts that Ma '586 discloses that the subcarriers are divided into non-contiguous sets for each antenna (presumably using the Examiner's alleged definition of "non-contiguous"), and acknowledges that Ma '586 does not specifically disclose the non-contiguous set as having
20 adjacent subcarriers. The Examiner asserts that assigning adjacent subcarriers to an antenna is well known in the art, as allegedly evidenced by Ma '255 (paragraphs [0126]-[0128]) and that therefore it would have been obvious to a person of ordinary skill in the art to use adjacent subcarriers to transmit the portion of (a) long training symbol.

Contrary to the Examiner's assertion, the word "contiguous" is defined as
25 "adjacent" (see, dictionary.com; second definition) and that the word "non-contiguous" therefore means "not adjacent." Appellants find *no* definition of the word "non-contiguous" that means "non-repetitive" and request that the Examiner provide evidence of this definition.

Also, as previously noted and acknowledged by the Examiner, Ma teaches that
30 "sub-carriers of a header OFDM symbol are divided into a non-contiguous set of sub-carriers for each of a plurality of antennas." (Paragraph [0030]; emphasis added; see, also, FIG. 5 and paragraphs [0031], [0034], [0090], and [0116]-[0117].) Based on the well known dictionary.com

definition of the term “non-contiguous”, Ma does *not* disclose or suggest *wherein each subcarrier subgroup comprises two or more adjacent subcarriers*.

In the Advisory Action, the Examiner asserts that, according to dictionary.com, “adjacent” can be taken to mean “lying near, close.”

Appellants note that dictionary.com defines “adjacent” to mean “being near or close, esp having a common boundary.” (Emphasis added.) As noted above, Ma does *not* disclose or suggest *wherein each subcarrier subgroup comprises two or more adjacent subcarriers*, i.e., subcarriers having a common boundary.

Furthermore, contrary to the Examiner’s assertion, Ma ‘255 does *not* assign adjacent subcarriers to one antenna; as disclosed in paragraphs [0126]-[0128] and associated FIG. 6; Ma teaches that every other subcarrier is assigned to antenna 21 and the remaining subcarriers are assigned to antenna 23. Independent claims 1 and 15 require transmitting a legacy preamble having at least one long training symbol, and at least one additional long training symbol on each of said N transmit antennas, each of said long training symbols having a plurality of subcarriers, wherein said subcarriers are grouped into a plurality of subcarrier subgroups, and *wherein each subcarrier subgroup comprises two or more adjacent subcarriers* and is transmitted on a different transmit antenna in a given time interval. Independent claims 27 and 30 require receiving a legacy preamble having at least one long training symbol and an indication of a duration of a transmission of said data, and at least one additional long training symbols on each of said N transmit antennas, each of said long training symbols having a plurality of subcarriers, wherein said subcarriers are grouped into a plurality of subcarrier subgroups, and *wherein each subcarrier subgroup comprises two or more adjacent subcarriers* and is transmitted on a different transmit antenna in a given time interval.

Thus, Perahia et al., Ma ‘586 and Ma ‘255, alone or in combination, do not disclose or suggest transmitting a legacy preamble having at least one long training symbol, and at least one additional long training symbol on each of said N transmit antennas, each of said long training symbols having a plurality of subcarriers, wherein said subcarriers are grouped into a plurality of subcarrier subgroups, and wherein each subcarrier subgroup comprises two or more adjacent subcarriers and is transmitted on a different transmit antenna in a given time interval, as required by independent claims 1 and 15, and do not disclose or suggest receiving a legacy preamble having at least one long training symbol and an indication of a duration of a

transmission of said data, and at least one additional long training symbols on each of said N transmit antennas, each of said long training symbols having a plurality of subcarriers, wherein said subcarriers are grouped into a plurality of subcarrier subgroups, and wherein each subcarrier subgroup comprises two or more adjacent subcarriers and is transmitted on a different transmit antenna in a given time interval, as required by independent claims 27 and 30.

Claims 6 and 20

Claims 6 and 20 are rejected under 35 U.S.C. §103(a) as being unpatentable over Perahia et al. in view of Ma '586, Ma '255, and Shattil. Regarding claim 6, the Examiner acknowledges that Perahia does not specifically teach wherein after transmission of said N long training symbols by each of said N transmit antennas, each of said N transmit antennas has transmitted each subcarrier of said long training symbols only once. The Examiner asserts, however, that Shattil teaches using different groups of subcarriers to modulate a symbol (paragraph [0081]) and that, therefore, if a different set of subcarriers are applied to a different symbol (e.g., the mapping is one to one), then the set of subcarriers will only be transmitted once for that series of symbols.

In the text cited by the Examiner, Shattil teaches:

[0081] *Various arrangements of CI sub-carriers are possible, such as non-contiguous and unequally spaced sub-carrier sets.* Equivalently, different symbol periods T_s relative to sub-carrier spacing(s) may be provided. In some aspects of the invention, different subcarriers and/or sub-carrier sets may be provided with different symbol durations. The spectrum of the resulting signal will vary accordingly. However, the spectral-efficiency advantages of CI are typically preserved. *For example, when subcarriers of a particular channel or subchannel are interleaved with other subcarriers, the sub-carrier spacing may be arranged such that multiple channels or subchannels are orthogonal to each other, even if their sub-carrier spectra overlap.*

(Paragraph [0081]; emphasis added.)

Appellants note that Shattil teaches “*various arrangements of CI sub-carriers are possible, such as non-contiguous and unequally spaced sub-carrier sets*”; Shattil does not disclose or suggest that each of N transmit antennas has transmitted each subcarrier of long training symbols *only once* after transmission of N long training symbols by each of N transmit antennas. Appellants find *no* logic in the Examiner’s assertion that, if a different set of subcarriers are applied to a different symbol, then the set of subcarriers will *only* be transmitted *once* for that series of symbols, and find *no* logic in asserting the Shattil teaches such an

assertion. Claims 6 and 20 require wherein after transmission of said N long training symbols by each of said N transmit antennas, each of said N transmit antennas has transmitted each subcarrier of said long training symbols only once.

5 Thus, Perahia et al., Ma '586, Ma '255, and Shattil, alone or in combination, do not disclose or suggest wherein after transmission of said N long training symbols by each of said N transmit antennas, each of said N transmit antennas has transmitted each subcarrier of said long training symbols only once, as required by claims 6 and 12.

Conclusion

10 The rejections of the cited claims under section 103 in view of Perahia et al., Ma '586, Ma '255, Shattil, Zhuang et al., and Jia et al., alone or in any combination, are therefore believed to be improper and should be withdrawn. The remaining rejected dependent claims are believed allowable for at least the reasons identified above with respect to the independent claims.

15 The attention of the Examiner and the Appeal Board to this matter is appreciated.

Respectfully,



20 Date: November 30, 2010

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CLAIMS APPENDIX

1. A method for transmitting data in a multiple antenna communication system having N transmit antennas, said method comprising the step of:

5 transmitting on each of said N transmit antennas a legacy preamble having at least one long training symbol, and at least one additional long training symbol, each of said long training symbols to be transmitted on each of said N transmit antennas having two or more portions, each of said N transmit antennas having a set of a plurality of subcarriers, wherein each of said sets of said plurality of subcarriers are grouped into a plurality of subcarrier subgroups, 10 wherein each subcarrier subgroup comprises two or more adjacent subcarriers and wherein each portion of each long training symbol is transmitted on a different transmit antenna in a given time interval using one of said plurality of subcarrier subgroups.

2. The method of claim 1, wherein said plurality of subcarrier subgroups are based 15 on a blocking technique.

3. The method of claim 1, wherein said plurality of subcarrier subgroups are based on an interleaving technique.

20 4. The method of claim 1, wherein each of said transmit antennas transmits a total of N long training symbols.

5. The method of claim 4, wherein said subcarrier subgroups transmitted by a given transmit antenna are varied for each of the N long training symbols transmitted by said given 25 transmit antenna.

6. The method of claim 5, wherein after transmission of said N long training symbols by each of said N transmit antennas, each of said N transmit antennas has transmitted each subcarrier of said long training symbols only once.

7. The method of claim 1, wherein a sequence of each of said long training symbols on each of said N transmit antennas are orthogonal.

8. The method of claim 1, wherein said legacy preamble further comprises at least 5 one short training symbol.

9. The method of claim 1, wherein said legacy preamble further comprises at least one SIGNAL field.

10 10. The method of claim 1, wherein said legacy preamble is an 802.11 a/g preamble.

11. The method of claim 1, wherein each of said long training symbols is orthogonal in the frequency domain.

15 12. The method of claim 1, wherein N is two and wherein said transmitting step further comprises the step of transmitting a legacy preamble having at least one long training symbol and one additional long training symbol on each of said two transmit antennas, wherein half of the subcarriers of the long training symbol are in a first subcarrier subgroup and the remaining half of the subcarriers of the long training symbol are in a second subcarrier subgroup.

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13. The method of claim 1, whereby a lower order receiver can interpret said transmitted data.

25 14. The method of claim 1, further comprising the step of transmitting a field indicating said number N of transmit antennas.

15. A transmitter in a multiple antenna communication system, comprising:
N transmit antennas for transmitting a legacy preamble having at least one long training symbol, and at least one additional long training symbol on each of said N transmit 30 antennas, each of said long training symbols to be transmitted on each of said N transmit antennas having two or more portions, each of said N transmit antennas having a set of a

plurality of subcarriers, wherein each of said sets of said plurality of subcarriers are grouped into a plurality of subcarrier subgroups, wherein each subcarrier subgroup comprises two or more adjacent subcarriers and wherein each portion of each long training symbol is transmitted on a different transmit antenna in a given time interval using one of said plurality of subcarrier subgroups.

- 5 16. The transmitter of claim 15, wherein said plurality of subcarrier subgroups are based on a blocking technique.
- 10 17. The transmitter of claim 15, wherein said plurality of subcarrier subgroups are based on an interleaving technique.
- 15 18. The transmitter of claim 15, wherein each of said transmit antennas transmits a total of N long training symbols.
19. The transmitter of claim 18, wherein said subcarrier subgroups transmitted by a given transmit antenna are varied for each of the N long training symbols transmitted by said given transmit antenna.
- 20 20. The transmitter of claim 19, wherein after transmission of said N long training symbols by each of said N transmit antennas, each of said N transmit antennas has transmitted each subcarrier of said long training symbols only once.
- 25 21. The transmitter of claim 15, wherein a sequence of each of said long training symbols on each of said N transmit antennas are orthogonal.
22. The transmitter of claim 15, wherein said legacy preamble further comprises at least one SIGNAL field.
- 30 23. The transmitter of claim 15, wherein said legacy preamble is an 802.11 a/g preamble.

24. The transmitter of claim 15, wherein each of said long training symbols is orthogonal in the frequency domain.

25. The transmitter of claim 15, wherein N is two and wherein said two transmit antennas transmit a legacy preamble having at least one long training symbol and one additional long training symbol on each of said two transmit antennas, wherein half of the subcarriers of the long training symbol are in a first subcarrier subgroup and the remaining half of the subcarriers of the long training symbol are in a second subcarrier subgroup.

10 26. The transmitter of claim 15, whereby a lower order receiver can interpret said transmitted data.

15 27. A method for receiving data on at least one receive antenna transmitted by a transmitter having N transmit antennas in a multiple antenna communication system, said method comprising the steps of:

20 receiving a legacy preamble having at least one long training symbol and an indication of a duration of a transmission of said data, and at least one additional long training symbols on each of said N transmit antennas, each of said long training symbols to be transmitted on each of said N transmit antennas having two or more portions, each of said N transmit antennas having a set of a plurality of subcarriers, wherein each of said sets of said plurality of subcarriers are grouped into a plurality of subcarrier subgroups, wherein each of said subcarrier subgroups comprises two or more adjacent subcarriers and wherein each portion of each long training symbol is transmitted on a different transmit antenna in a given time interval using one of said plurality of subcarrier subgroups; and

25 deferring for said indicated duration of said transmission of said data.

28. The method of claim 27, wherein said method is performed by a SISO receiver.

29. The method of claim 27, wherein said indication is transmitted in a SIGNAL field
30 that complies with the 802.11 a/g standards.

30. A receiver in a multiple antenna communication system having at least one transmitter having N transmit antennas, comprising:

at least one receive antenna for receiving a legacy preamble having at least one long training symbol and an indication of a duration of a transmission of said data, and N-1
5 additional long training symbols on each of said N transmit antennas, each of said long training symbols to be transmitted on each of said N transmit antennas having two or more portions, each of said N transmit antennas having a set of a plurality of subcarriers, wherein each of said sets of said plurality of subcarriers are grouped into a plurality of subcarrier subgroups, wherein each of said subcarrier subgroups comprises two or more adjacent subcarriers and wherein each portion
10 of each long training symbol is transmitted on a different transmit antenna in a given time interval using one of said plurality of subcarrier subgroups; and

means for deferring for said indicated duration of said transmission of said data.

EVIDENCE APPENDIX

There is no evidence submitted pursuant to § 1.130, 1.131, or 1.132 or entered by the Examiner and relied upon by appellant.

RELATED PROCEEDINGS APPENDIX

There are no known decisions rendered by a court or the Board in any proceeding identified pursuant to paragraph (c)(1)(ii) of 37 CFR 41.37.